



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/EP92/00648 <b>(22) International Filing Date:</b> 23 March 1992 (23.03.92) <b>(30) Priority data:</b> 9107826.1                      12 April 1991 (12.04.91)                      GB <b>(71) Applicants:</b> WEATHERFORD/LAMB, INC. [US/US]; 1360 Post Oak Boulevard, Suite 1000, Houston, TX 77227 (US). LUCAS, Brian, Ronald [GB/GB]; 135 West- hall Road, Warlingham, Surrey CR6 9HJ (GB). <b>(72) Inventor:</b> PIETRAS, Bernd-Georg ; Sandriedeweg 12, D- 3001 Wedemark 2 (DE). <b>(74) Agent:</b> LUCAS, Brian, Ronald; Lucas & Co, 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).		<b>(81) Designated States:</b> AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), LU (European patent), MC (European patent), NL (European patent), NO, SE (European patent).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> ROTARY FOR USE IN A POWER TONG <div style="text-align: center; margin-top: 20px;"> </div>		
<b>(57) Abstract</b>  The rotary (2) of a power tong (1) contains a master piston and cylinder (19) which, when actuated, delivers hydraulic fluid to slave hydraulic piston and cylinders (14, 15) which apply active jaws (8, 9) against a pipe (5). The master piston and cylinder (19) can be depressed by a plunger (29) mounted on top the tong housing (45). The active jaws (8, 9) can be released by opening one or both valves (39, 40) mounted on the rotary (2) and actuatable by depressing a ring (49) mounted on the top of the tong housing (45).		

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ROTARY FOR USE IN A POWER TONG

This invention relates to a rotary for use in a power tong.

In drilling operations it is necessary to connect  
5 and disconnect successive lengths of pipe which are provided with threaded connections. The tools used for holding the pipes while they are being screwed together are known as tongs. Power tongs generally include a rotary for rotating the pipe whilst back-up tongs simply  
10 hold a pipe fast.

Tongs are generally provided with one or more jaws which can be moved into engagement with a pipe. In a typical arrangement two "passive" jaws are fixed in a tong whilst a third "active" jaw can be advanced towards  
15 or retracted away from a pipe as desired. In one power tong the active jaw is mounted in a jaw holder, the radial extremity of which is provided with a roller which rests on a cam surface formed on a rotary. When the rotary rotates relative to the jaw holder the roller  
20 rides along the cam surface and urges the jaw against the pipe with a force which is a function of the slope of the cam surface. Once the jaw is firmly applied the pipe and rotary rotate in unison.

Whilst such power tongs work in a satisfactory  
25 manner they can only be used with pipes having a small range of diameters. In order to accommodate substantially larger or smaller diameter pipes it is necessary to change the cam surface either completely or by adding wedges. This is a time-consuming and expensive  
30 procedure.

In order to overcome this problem it has been proposed to provide a rotary for use in a power tong, which rotary comprises a slave hydraulic piston and cylinder, a jaw carrier associated with said slave  
35 hydraulic piston and cylinder, and means to selectively

retain hydraulic fluid in said slave hydraulic piston and cylinder.

In this arrangement, a master hydraulic piston and cylinder is mounted alongside the rotary. In use the master hydraulic piston and cylinder is connected to the slave piston and cylinder by a hose having a releasable coupling. Hydraulic fluid is then pumped from the master hydraulic piston and cylinder to the slave piston and cylinder to apply the jaw(s). Once the desired pressure is reached valves either side of the coupling are closed and the releasable coupling disconnected to enable the rotary to be rotated.

In order to release the jaws the hose is reconnected, the valves opened and the hydraulic fluid allowed to return to a reservoir.

The repeated coupling and disconnection of the releasable coupling is a time-consuming process and great care has to be taken to ensure that the releasable couplings are correctly attached and that the hoses connected thereto are not damaged.

The present invention reduces these problems and is characterized in that the rotary further comprises a master hydraulic piston and cylinder.

Preferably, said means to selectively retain hydraulic fluid in said slave hydraulic piston and cylinder comprises a valve.

Advantageously, said means includes two valves connected in parallel.

Preferably, an hydraulic accumulator is placed in communication with said slave hydraulic piston and cylinder to help compensate for any leakage and absorb shock loads transmitted through said jaw holder.

In a preferred embodiment, the master hydraulic piston and cylinder comprises a major cylinder and a minor cylinder, wherein:

- (a) the major cylinder communicates with a pressure relief valve and is connected to said slave hydraulic piston and cylinder via a non-return valve; and
- 5 (b) said minor cylinder is connected to said slave piston and cylinder via a non-return valve; the arrangement being such that, in use, said master hydraulic piston and cylinder is capable of delivering hydraulic fluid to said slave piston and cylinder at a
- 10 first volumetric flow rate until the pressure in said slave piston and cylinder reaches a first pressure at which said pressure relief valve opens, and then at a second volumetric flow rate lower than said first volumetric flow rate but at a pressure higher than said
- 15 first pressure.

The present invention also provides a power tong provided with a rotary in accordance with the present invention.

20 Preferably, the power tong includes a tong housing, and a plunger is mounted on the tong housing and is movable to actuate the master hydraulic piston and cylinder, preferably a predetermined number of times.

25 Preferably, said plunger forms part of a hydraulic actuator and means are provided to inhibit operation of said hydraulic actuator when said plunger is not aligned with said piston.

30 If desired, the jaw can be formed as an integral part of the jaw holder although it will normally be formed as a separate part which can be mounted on the jaw holder.

It will be appreciated that with the arrangement described the pressure which the jaws apply to the pipe can be accurately controlled and, once set, remains constant. Thus, power tongs incorporating the present

35 rotary can be quickly adapted to handle pipes of the

same diameter but made from very different materials or pipes of different diameters.

In a particularly preferred embodiment, a master hydraulic piston and cylinder is arranged to control a plurality of slave hydraulic cylinders disposed circumjacent the pipe opening in a tong and associated with a multiplicity of jaw holders. It will be appreciated that such an arrangement applies a substantially uniform gripping pressure to the circumference of the pipe.

When one or two valves are provided to selectively retain hydraulic fluid in the slave hydraulic piston and cylinder the or both valves are preferably actuable by a ring mounted on the tong housing and movable into contact with the valves.

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For a better understanding of the present invention, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a top plan view of a power tong in accordance with the invention;

Figure 2 is a flow sheet showing the interconnection of certain parts in the rotary of the power tong shown in Figure 1; and

Figure 3 is a schematic exploded view of part of the power tong shown in Figure 1.

Referring to the drawings, there is shown a power tong which is generally identified by reference numeral 1.

The power tong 1 houses a rotary 2 having an opening 3 closed by a gate 4. Gate 4 can be opened and the power tong 1 can be moved so that a pipe 5, shown in outline, can be received in the centre of the power tong 1. The pipe 5 is gripped in this position by two passive jaws 6, 7 and two active jaws 8, 9 which are shown fully advanced in their pipe gripping position. Active jaws 8, 9 are carried on jaw carriers 10, 11 which form the cylinders 12, 13 of twin slave piston and cylinder assemblies 14, 15.

An hydraulic control assembly 16 is also located in the rotary 2. The hydraulic control assembly 16 comprises a reservoir 17 which is connected to the major cylinder 18 of a master hydraulic piston and cylinder 19 by a line 20 having a non-return valve 21 mounted therein.

A pressure relief valve 22 is situated downstream of the non-return valve 21 and, when open, returns hydraulic fluid to the reservoir 17.

The master hydraulic piston and cylinder 18 is divided into major cylinder 18 and minor cylinder 23. The piston 24 comprises a major land 25 which slides in

major cylinder 18 and a spool 26 which slides in minor cylinder 23. The major land 25 is provided with a seal 27 whilst the spool 26 is provided with a seal 28. The piston 24 can be depressed against the restoring action  
5 of a spring 30 by a plunger 29.

A delivery line 31 connects the major cylinder 18 to a non-return valve 32. A delivery line 33 connects the non-return valve 32 to a delivery line 34 leaving the bottom of the minor cylinder 23 and thence to a non-  
10 return valve 35. A supply pipe 36 connects the non-return valve 35 to the slave twin piston and cylinder assemblies 14 and 15.

A pneumatic accumulator 37 is connected to the supply pipe 36 as is a return line 38 which is connected  
15 to two valves 39 and 40 which are connected in parallel. A return line 41 is arranged to return hydraulic fluid to the reservoir 17 via a variable orifice 42.

Finally, a line 43 connects the reservoir 17 to minor cylinder 23 via a line 43 and a non-return valve  
20 44.

With the exception of the plunger 29 all the components thus far described are mounted in the rotary  
2.

At the commencement of a coupling operation rotary  
25 2 is rotated until its opening is aligned with the opening in the tong housing 45 as shown in Figure 1. In this position plunger 29, which is contained within an hydraulic actuator 46, is disposed directly above the piston 24 of the master hydraulic piston and cylinder  
30 19.

At this stage active jaws 8 and 9 are fully retracted so that when the gate 4 is opened the power tong 1 can be slipped over pipe 5 until it rests against passive jaws 6 and 7, the positions of which have been  
35 pre-set according to the diameter of the pipe 5.



Once the pipe 5 is in position a signal is sent to hydraulic actuator 46 to depress the plunger 29 a predetermined number of times in accordance with information stored on a computer. Execution of this instruction is delayed whilst an enquiry is sent to position sensors 47 and 48 to confirm that the rotary 2 is in a position such that plunger 29 is above piston 24.

Assuming all is well, the plunger depresses piston 24. At this time both the major cylinder 18 and the minor cylinder 23 are full of hydraulic fluid which has entered via line 20 and non-return valve 21 and via line 43 and non-return valve 44 respectively.

The hydraulic fluid passes to the supply pipe 36 and enters the cylinders 12, 13 of the twin piston and cylinder assemblies 14 and 15. This displaces the jaw carriers 10, 11 radially inwardly. During this time valves 39 and 40 are closed as shown.

As the active jaws 8, 9 move into engagement with the pipe 5 the pressure in supply pipe 36 increases. At a certain pressure, pressure relief valve 22 opens so that when plunger 29 is depressed the hydraulic fluid in major cylinder 18 is simply returned to the reservoir 17. However, the hydraulic fluid in minor cylinder 23 is still directed to the supply pipe 36. The hydraulic fluid from the minor cylinder 23 is prevented from flowing to the major cylinder 18 by non-return valve 32.

It will be appreciated that the arrangement described provides a relatively large volume of hydraulic fluid to be supplied to the two piston and cylinder assemblies 14 and 15 at a first pressure. However, when the pressure reaches a certain level the arrangement delivers a small volume at a second pressure higher than the first pressure.

It will be noted that the gripping force is

determined by the master hydraulic piston and cylinder 19.

When it is desired to release the pipe one or both of valves 39 and 40 are opened against the bias of springs 49, 50 to allow hydraulic fluid from the twin piston and cylinder assemblies 14 and 15 to return to the reservoir 17.

During a tightening operation the rotary 2 may be stopped in any position relative to the tong housing 45. In order to actuate at least one of the valves 39, 40 a ring 49 is provided which is supported from the cover 50 of the tong housing 45 by the pistons 51, 52, 53 of three hydraulic actuators 54, 55, 56. The pistons 51, 52, 53 are biased upwardly by springs 57, 58, 59 respectively.

When it is desired to open valves 39 and 40, hydraulic fluid is introduced into the top of hydraulic actuators 54, 55 and 56 and displaces the ring 49 downwardly. By using two valves 39 and 40, the jaws 6 and 7 can be released irrespective of the position of the rotary 2 relative to the tong housing 45.

Various modifications to the arrangement disclosed are envisaged. For example, only one active jaw need be present. Alternatively, the pipe could be surrounded by a multiplicity of active jaws each operable by a common master hydraulic piston and cylinder.

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CLAIMS:

1. A rotary for use in a power tong, which rotary (2) comprises a slave hydraulic piston and cylinder (14, 15), a jaw carrier (10, 11) associated with said slave  
5 hydraulic piston and cylinder (14, 15), and means (35, 39, 40) for selectively retaining hydraulic fluid in said slave hydraulic piston and cylinder (14, 15); characterized in that said rotary (2) further comprises a master hydraulic piston and cylinder (19).
- 10 2. A rotary as claimed in Claim 1, characterized in that said means comprises a valve (39, 40).
3. A rotary as claimed in Claim 1 or 2, characterized in that said means comprises two valves (39, 40) connected in parallel.
- 15 4. A rotary as claimed in Claim 1, 2 or 3, characterized in that it includes a pneumatic accumulator (37) which communicates with said slave hydraulic piston and cylinder (14, 15).
5. A rotary as claimed in any preceding Claim,  
20 characterized in that said master hydraulic piston and cylinder (19) comprises a major cylinder (18) and a minor cylinder (23), wherein:
  - (a) said major cylinder (18) communicates with a pressure relief valve (22) and is connected to said  
25 slave hydraulic piston and cylinder (14, 15) via a non-return valve (32); and
  - (b) said minor cylinder (23) is connected to said slave piston and cylinder (14, 15) via a non-return valve (35),
- 30 the arrangement being such that, in use, said master hydraulic piston and cylinder (19) is capable of delivering hydraulic fluid to said slave piston and cylinder (14, 15) at a first volumetric flow rate until the pressure in said slave piston and cylinder (14, 15)  
35 reaches a first pressure at which said pressure relief

valve (22) opens, and then at a second volumetric flow rate lower than said first volumetric flow rate but at a pressure higher than said first pressure.

5 6. A power tong provided with a rotary as claimed in any preceding Claim.

7. A power tong as claimed in Claim 6, and including a tong housing (45), characterized in that a plunger (29) is mounted on said tong housing (45) and is movable to actuate said master hydraulic piston and cylinder (19).

10 8. A power tong as claimed in Claim 7, characterized in that said plunger (29) forms part of an hydraulic actuator (46) and means (47, 48) are provided to inhibit operation of said hydraulic actuator (46) until said plunger (29) is aligned with said master hydraulic  
15 piston and cylinder (19).

9. A power tong as claimed in Claim 6, 7 or 8, including a plurality of slave hydraulic cylinders disposed circumjacent a pipe opening in a tong and associated with a multiplicity of jaw holders.

20 10. A power tong as claimed in Claim 6, 7, 8 or 9, when appended directly or indirectly on Claim 2 or 3, characterized in that the or both valves (39, 40) are actuatable by a ring (45) mounted on said tong housing (45) and movable into contact with said valves (39, 40).

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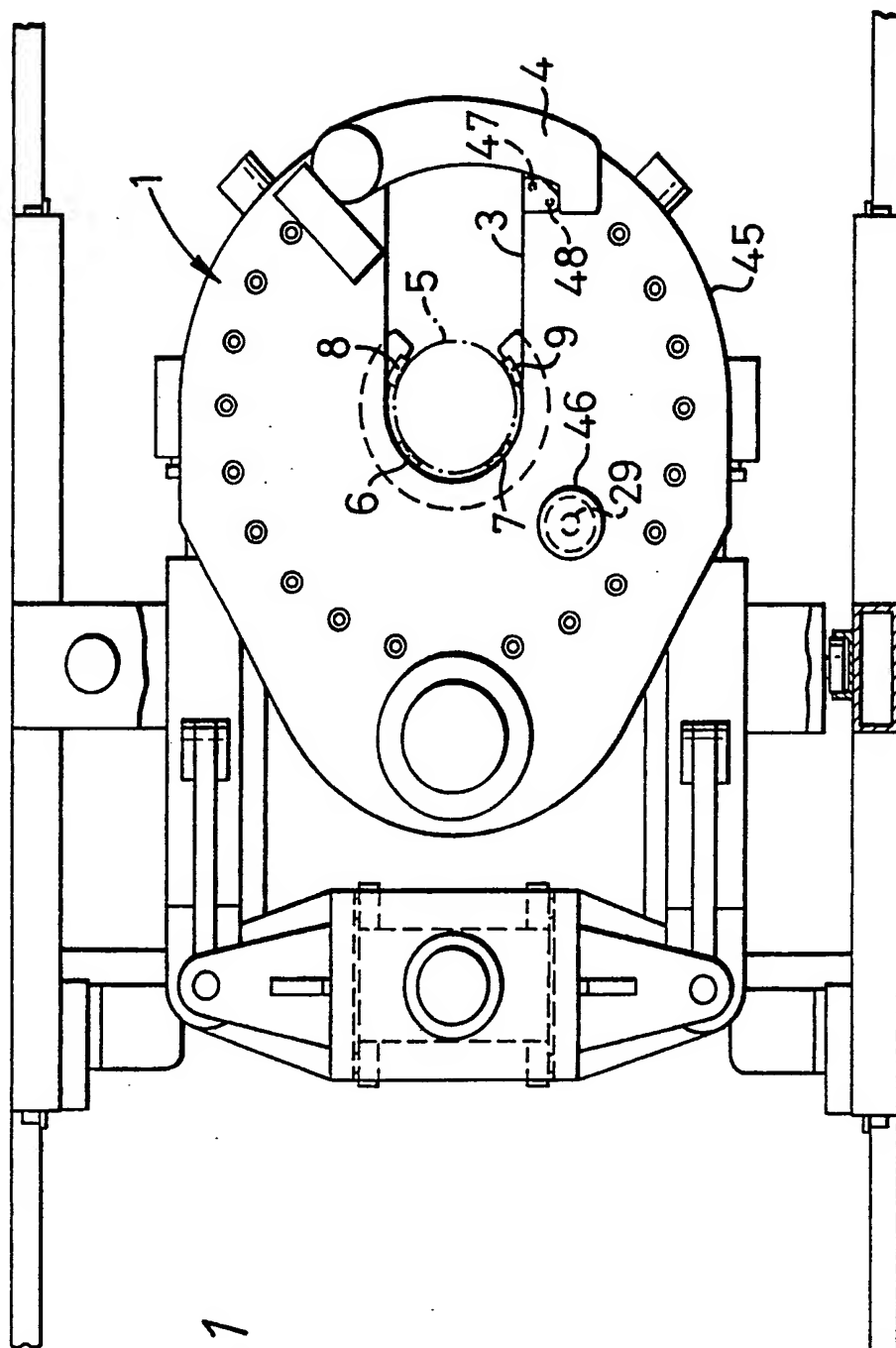
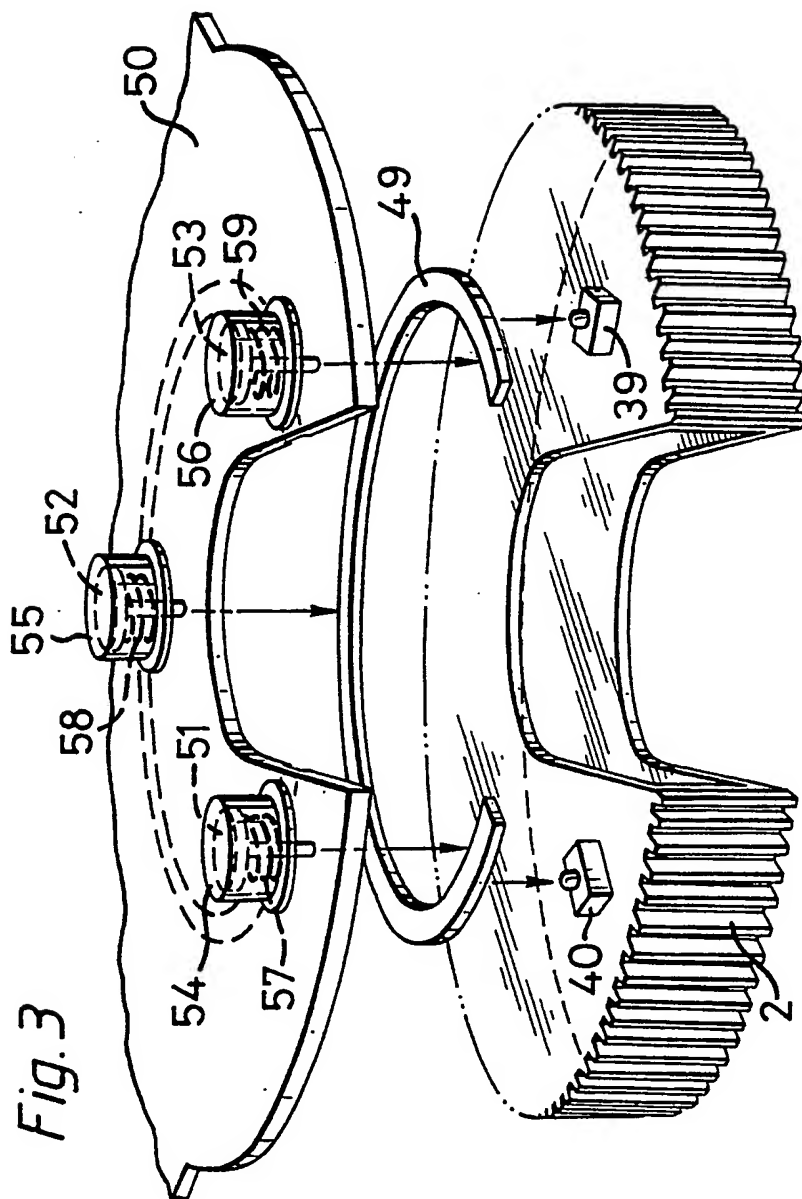


Fig.1

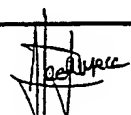




## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 92/00648

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 E21B19/16		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	E21B	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	US,A,4 402 239 (MOONEY) 6 September 1983  see column 8, line 1 - line 38; figure 7  ---	1,2,3,6, 9
<p><sup>10</sup> Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
12 JUNE 1992	24. 06. 92	
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SA 57436

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4402239	06-09-83	CA-A- 1150234	19-07-83
		DE-A, C 3016744	13-11-80
		GB-A, B 2049518	31-12-80
		NL-A- 8002503	03-11-80

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